SIEMENS

PATENT
Attorney Docket No. 00P7919US

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

#13
9.29.2

In re Application of:

Inventor:	Gordon Israelson	)	
		)	Group Art Unit: 1745
Serial No.:	09/669,784	)	
		)	Examiner: D. Yuan
Filed:	September 25, 2000	)	

Title: DESULFURIZATION FOR FUEL CELL SYSTEMS USING SULPHUR SEPARATING MEMBRANES

APPELLANT'S BRIEF

Assistant Commissioner for Patents
Washington, DC 20231

Dear Sir:

This Appeal Brief relates to an appeal from the final rejection of claims 1-20 in the Office Action dated April 23, 2002.

Real Party in Interest

This application is assigned to Siemens Westinghouse Power Corporation of Orlando, Florida, USA.

Related Appeals and Interferences

No related appeals or interference proceedings are currently pending that would directly affect or be directly affected by or have a bearing on the Board's decision in this appeal.

Status of Claims

Claims 1-20 are rejected and are under appeal.

Status of Amendments

An amendment after final under 37 CFR § 1.116 was proposed on May 20, 2002. The Examiner stated in an Advisory Action dated June 20, 2002 that the amendment was considered but did not place the application in condition for allowance.

Summary of Invention

Referring to Figure 1, Applicant's invention is directed toward a process to desulfurize a sulfur containing fuel gas used as a feed fuel for a fuel cell system (36), and toward a method of reducing the sulfur concentration in a sulfur containing fuel gas used as a feed fuel for a fuel cell system. Applicant's invention (1) segregates the fuel feedstock stream (10) into a high-sulfur stream (18) and a low-sulfur stream (20), see, e.g., spec, page 7, lines 20-22; (2) passes the high-sulfur stream (18) back into the fuel feedstock (10), see, e.g., spec, page 7, lines 23-25; (3) passes the low-sulfur stream (20) through a sulfur selective membrane (16) to reduce the sulfur content, see, e.g., spec, page 7, lines 20-22; and (4) passes the low-sulfur stream (20) through a sulfur sorbent medium (28) to further reduce the sulfur content for use as a feed fuel for the fuel cell system (36), see, e.g., spec, page 8, lines 8-11.

Issues

1. Whether claims 1-20 are obvious under 35 U.S.C. §103 over G.B. Patent No. 2,289,286 to Willis ("Willis") in view of U.S. Patent No. 4,202,865 to Preston, Jr. ("Preston").

Appellant's Argument

Claims 1-20 stand rejected under 35 U.S.C. § 103(a), the Examiner contending that these claims are obvious over Willis in view of Preston. The Examiner apparently reads Willis as teaching the claimed invention except for using the feed fuel for a fuel cell system as taught by Preston and believes that it would have been obvious to combine Carnell with Preston.

Applicant respectfully disagrees with the Examiner's reading of Willis. Willis addresses the problem of high sulfur fuel feedstocks and provides a method for the reduction of sulfur concentration in a fuel feedstock. In particular, Willis (a) segregates the fuel feedstock stream into a high-sulfur stream (minor permeate) and a low-sulfur stream (major impermeate), (b) passes the high-sulfur stream to a regenerable liquid to reduce the hydrogen sulfide from the high-sulfur stream and produce a first reduced-sulfur stream, (c) passes the low-sulfur stream to a non-regenerable solid hydrogen sulphide absorbent to reduce the hydrogen sulfide from the low-sulfur stream and produce a second reduced-sulfur stream, and (d) combines the first reduced-sulfur stream with the second reduced-sulfur stream to provide a fuel feedstock having a reduced sulfur concentration.

In contrast, Applicant's invention is not directed toward reducing sulfur concentration in fuel feedstocks. Rather, Applicant's invention is directed toward providing a fuel cell system with a low-sulfur concentration fuel. In particular, Applicant's invention (1) segregates the fuel feedstock stream into a high-sulfur stream and a low-sulfur stream, (2) passes the high-sulfur stream back into the fuel feedstock, (3) passes the low-sulfur stream through a sulfur selective membrane to reduce the sulfur content, and (4) passes the low-sulfur stream through a sulfur sorbent medium to further reduce the sulfur content for use as a feed fuel for the fuel cell system.

Thus, among other things, Willis is significantly different because it combines the first reduced-sulfur stream with the second reduced-sulfur stream to provide a fuel feedstock having an overall reduced sulfur concentration. In contrast, Applicant's invention segregates the

reduced sulfur high-sulfur stream from the low-sulfur stream, passing the high-sulfur stream back into the fuel feedstock which increases the fuel feedstock sulfur content and assists in gas leak detection. (see e.g. spec., page 3 lines 23 - 30), and passing the low-sulfur stream through to the fuel cell system to allow the fuel cell system to operate with the preferred low-sulfur fuel (see e.g. spec., page 1 lines 23 - 29).

Willis is also significantly different because it passes the high-sulfur stream to a regenerable liquid to produce a reduced sulfur stream. In contrast, Applicant's invention passes the high-sulfur stream back into the fuel feedstock without reducing its sulfur content. (see e.g. spec., page 7, lines 23-29).

Response to Advisory Action

In the Advisory Action, the Examiner asserts that Applicant's claims "do not require segregation of fuel streams." Applicant respectfully disagrees. Claims 1-20 recite "separating the gas into a sulfur concentrated stream and a sulfur lean stream". Applicant respectfully considers this language to clearly require segregation of the fuel stream.

Also in the Advisory Action, the Examiner asserts that Applicant's claims, broadly read, "encompasses feeding the sulfur-rich fuel stream in alternate locations, as indicated by the marked up copy of applicant's Figure 1." Applicant respectfully disagrees. Claims 1-20 recite "passing the sulfur concentrated stream back into the main fuel feed stream" and claims 19 and 20 further recite that "the sulfur concentrated stream does not mix with the sulfur lean stream". Applicant respectfully considers that claims 1-20 clearly require the sulfur rich stream to be passed back into the main fuel feed stream, which is not met by the Examiner's marked up copy of Figure 1. Applicant also respectfully considers that claims 19 and 20 clearly further require the sulfur concentrated stream not to be mixed with the sulfur lean stream, which is not met by the Examiner's marked copy of Figure 1.

Based on the foregoing, Applicant respectfully submits that claims 1-20 are patentable. The honorable Board is therefore respectfully urged to reverse the final rejection of the Examiner and to remand the application to the Examiner with instructions to allow claims 1-20 under appeal.

Grouping of Claims

Claim sets 1-10 and 11-18 stand or fall together, as explained in the Argument section above. Claims 19 and 20 separately stand or fall together, as explained in the Argument section above.

Please charge the $320.00 fee for filing this Brief, and any other fees that might be due with respect to Sections 1.16 and 1.17 or this Appeal to the Deposit Account No. 19-2179. No fees for an extension of time are required.

Respectfully submitted,

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Appendix - Appealed Claims:

1. A process to desulfurize sulfur containing fuel gas used as feed fuel for fuel cell system comprising the steps:

(1) providing a main feed stream of sulfur containing fuel gas containing at least 0.30 ppm of odorous sulfur compounds; and then

(2) passing part of that main feed stream of sulfur containing fuel gas and compressing it to a pressure over 304 kPa; and then

(3) passing the compressed sulfur containing fuel gas to sulfur selective membrane, where the gas is separated into a sulfur concentrated stream, and a sulfur lean stream containing no more than 0.20 ppm of sulfur compounds; and then

(4) passing the sulfur concentrated stream back to the main feed stream down stream from where the stream of step (2) was provided; and then

(5) optionally measuring gas flow and reducing gas pressure; and then

(6) passing the sulfur lean stream through a sulfur sorbent medium to collect sulfur, providing an essentially sulfur free stream containing no more than 0.10 ppm of sulfur compounds; and

(7) optionally reforming the essentially sulfur free stream prior to passing it to contact a fuel cell.

2. The method of Claim 1, where the main feed stream is natural gas stream.

3. The method of Claim 1, where the main feed stream contains odorous sulfur compounds selected from the group consisting of mercaptans, sulfides, and thiophenes and mixtures thereof.

4. The method of Claim 1, where the main feed stream is a natural gas stream containing odorous sulfur compounds selected from the group consisting of tertiary butyl mercaptan, dimethyl sulfide, tetrahydrothiophene and mixtures thereof.

5. The method of Claim 1, where the sulfur free stream is reformed in step (7).

6. The method of Claim 1, where the fuel cell is an axially elongated solid oxide fuel cell.

7. The method of Claim 1, where the fuel cell is contacted with a pressurized, essentially sulfur free stream in step (7).

8. The method of Claim 1, where gas flow is measured between steps (4) and (6).

9. The method of Claim 1, where the sulfur containing fuel gas passed to the sulfur selective membrane is at a pressure between 304 kPa and 20670 kPa.

10. The method of Claim 1, where the essentially sulfur free stream provided in step (6) contains between about 0.025 ppm and 0.075 ppm of sulfur compounds.

11. A method of reducing the sulfur concentration in a sulfur containing fuel gas used as feed fuel for a fuel cell system, comprising:

providing a main fuel feed stream containing a sulfur containing fuel gas;

pressurizing at least a portion of the sulfur containing fuel gas;

passing at least a portion of the pressurized sulfur containing fuel gas through a sulfur selective membrane to separate the gas into a sulfur concentrated stream and a sulfur lean stream, the sulfur concentrated stream having a higher sulfur concentration than the sulfur lean stream;

passing the sulfur concentrated stream back into the main fuel feed stream downstream from where the sulfur containing fuel gas is pressurized; and

passing the sulfur lean stream through a sulfur sorbent medium to reduce the sulfur concentration in the sulfur lean stream.

12. the method of claim 11, wherein the sulfur containing fuel gas contains at least 0.30 ppm of odorous sulfur compounds.

13. The method of claim 11, wherein the sulfur containing fuel gas is pressurized to a pressure greater than 304 kpa.

14. the method of claim 11, wherein the sulfur lean stream contains no more than 0.20 ppm of sulfur compounds.

15. The method of claim 11, wherein a gas flow is measured and a gas pressure is adjusted based upon the gas flow measurement.

16. The method of claim 15, wherein the gas flow is measured prior to passing the sulfur lean stream through the sulfur sorbent medium.

17. The method of claim 11, wherein the sulfur sorbent medium reduces the sulfur concentration in the sulfur lean stream to no more than 0.10 ppm of sulfur compounds.

18. The method of claim 11, wherein the sulfur lean stream is reformed prior to contacting a fuel cell.

19. A method of reducing the sulfur concentration in a sulfur containing fuel gas used as feed fuel for a fuel cell system, comprising:

providing a main fuel feed stream containing a sulfur containing fuel gas;

passing at least a portion of the sulfur containing fuel gas through a sulfur selective membrane to separate the gas into a sulfur concentrated stream and a sulfur lean stream, the sulfur concentrated stream having a higher sulfur concentration than the sulfur lean stream;

passing the sulfur concentrated stream back into the main fuel feed stream such that the sulfur concentrated stream does not mix with the sulfur lean stream; and

passing the sulfur lean stream through a sulfur sorbent medium to reduce the sulfur concentration in the sulfur lean stream for use as the feed fuel for the fuel cell system.

20. The method of claim 19, wherein at least a portion of the sulfur containing fuel gas is pressurized to over 304kpa prior to passing the sulfur containing fuel gas through the sulfur selective membrane.